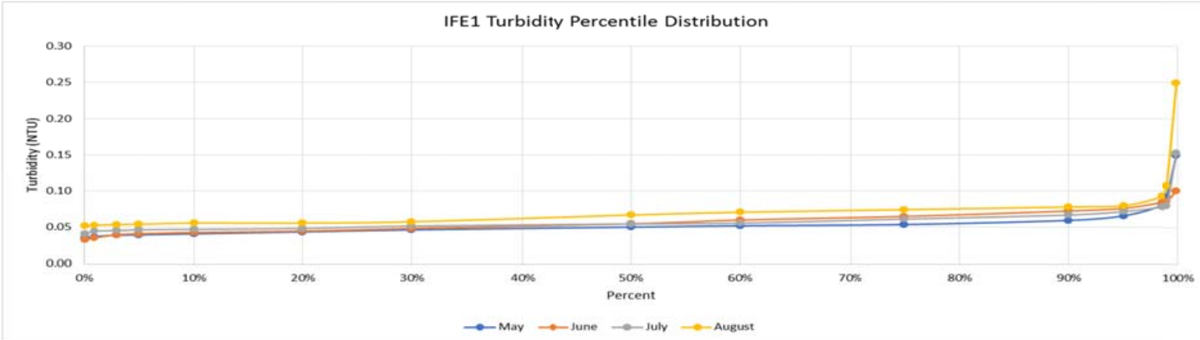
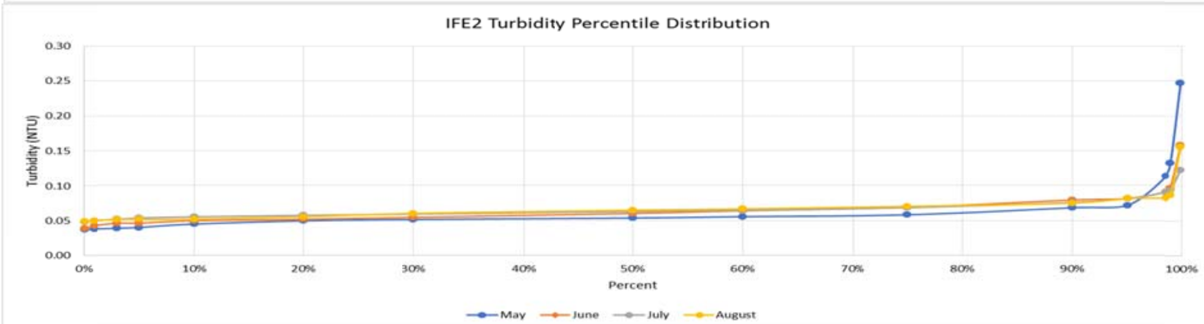
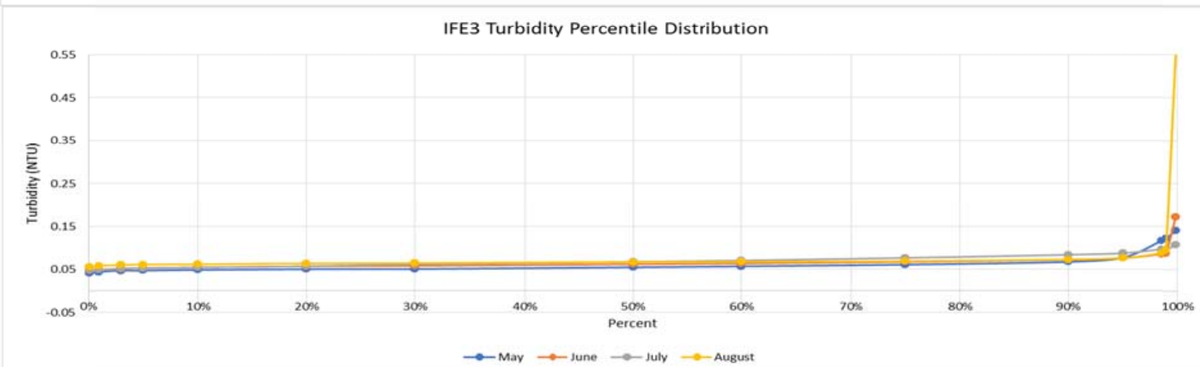
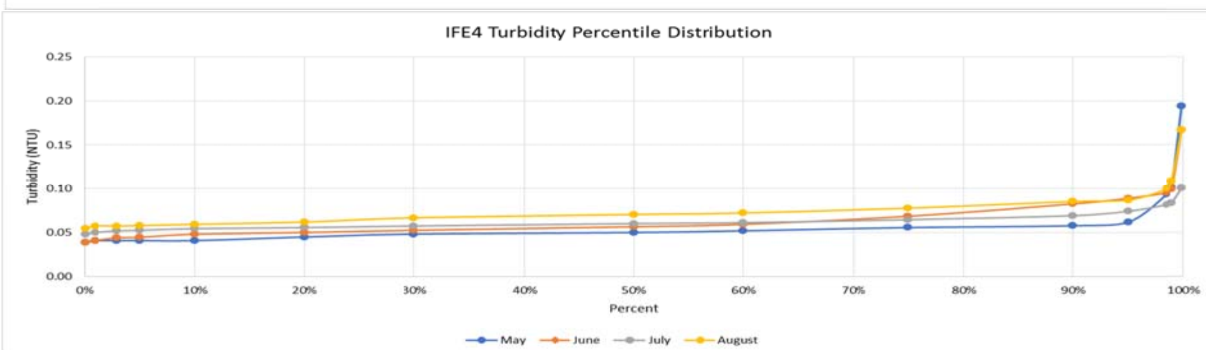
HRSD SWIFT Research Center (SWIFTRC) Quarterly Report on SWIFT Water Quality Targets

This report documents SWIFT Water Quality results for the first full quarter of recharge operations which includes the period from May 15, 2018 – August 31, 2018. The compliance requirements are documented in HRSD's SWIFT Underground Injection Control Inventory Information Package (UIC-IIP) submitted to EPA Region III in January 2018. These requirements are noted in the following tables (Tables 1-4), extracted from Attachment B of the UIC-IIP. Figures 1 and 2 and Table 5 provide the data from the first full quarter of operations relative to these SWIFT Water Quality Targets.

Parameter	Proposed Regulatory Limit	Non-Regulatory Action/Goal
EPA Drinking Water Primary Maximum Contaminant Levels (MCLs)	Meet all primary MCLs	N/A
Total Nitrogen	5 mg/L Monthly Average; 8 mg/L Max Daily	Secondary Effluent Critical Control Point (CCP) Action Limit for Total Inorganic Nitrogen (TIN) = 5 mg/L-N; CCP Action Limit for SWIFT Water Total Nitrogen (TN) = 6 mg/L-N[1]
Turbidity	Individual Filter Effluent (IFE) < 0.15 NTU 95% of time and never >0.3 NTU in two consecutive 15 min measurements	CCP Action Limit IFE of 0.10 NTU to initiate backwash or place a filter in standby
Total Organic Carbon (TOC)	4 mg/L Monthly Average 6 mg/L Maximum	Critical Operating Point (COP) Action Limit to Initiate GAC Regeneration; See Table 8 COP for GAC TOC
Total Coliform	<2 CFU/100 mL 95% of time; Not to exceed geometric mean of 3 CFU/100 mL, based on a running calculation of 20 days of daily samples for total coliforms	N/A
E.coli	Non-detect	N/A
TDS	N/A	Monitor PAS Compatibility

Table 1: SWIFT Regulatory and Monitoring Limits for SWIFT Water (Table 4-1 of the UIC-IIP).

[1] Total Inorganic Nitrogen (TIN) CCP for the secondary effluent as proposed in the UIC-IIP was 6 mg/L-N. Though compliant with the SWIFT Water regulatory targets, August 2018 Total Nitrogen concentrations in SWIFT Water trended upward (see Table 5). As an additional measure of protection, the TIN CCP was adjusted to 5 mg/L and an additional CCP was added to the SWIFT Water for TN. Further discussion on Total Nitrogen can be found in the SWIFTRC Quarterly Research Report issued October 11, 2018.


IFE1 Turbidity Percentile Distribution
Turbidity (NTU)
Percent
May
June
July
August

IFE2 Turbidity Percentile Distribution
Turbidity (NTU)
Percent
May
June
July
August

IFE3 Turbidity Percentile Distribution
Turbidity (NTU)
Percent
May
June
July
August

IFE4 Turbidity Percentile Distribution
Turbidity (NTU)
Percent
May
June
July
August

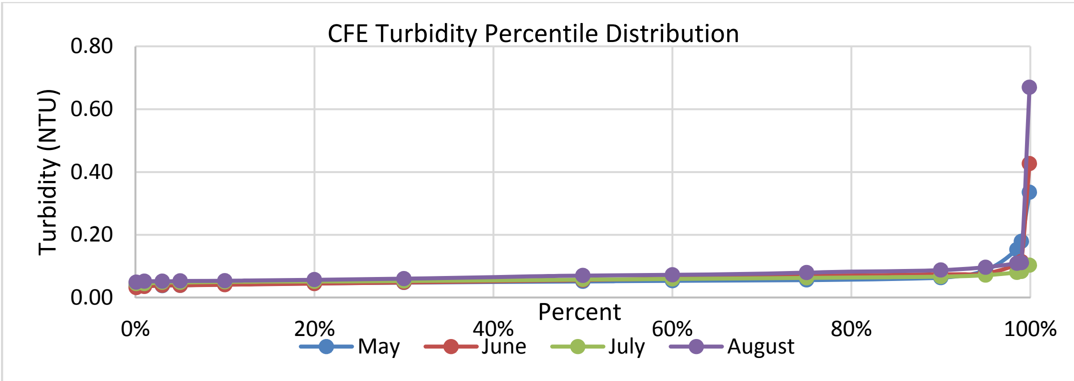


Figure 1: Percentile distribution of 15-minute average Individual Filter Effluent (IFE) Turbidities for Biofilters 1-4 (IFE1-4) and Combined Filter Effluent (CFE).

Note turbidity in IFE3 was >0.3 NTU in August in three consecutive readings on August 21. Recharge was not occurring at the time. However, the Critical Control Point (CCP) which should have triggered a diversion of the filter effluent, and the filters should have gone into standby. This did not happen, and it is being investigated. The Granular Activated Carbon (GAC) feed pumps were not running and the GAC Feed Pump Station was cleared of the high turbidity water before recharge was restarted. The current CCP action for IFE alarm level exceedances (>0.15 NTU) is to place that respective filter in standby, and the current CCP action for CFE alarm level exceedances (>0.15 NTU) is to divert SWIFT. The actions for both of these CCPs will be modified such that IFE alarms cause that specific filter to move to filter-to-waste mode, and a CFE alarm causes all biofilters to move to filter-to-waste mode.

Turbidity in excess of 0.3 NTU has been recorded by the combined filter effluent turbidimeter on several occasions. However, during each time the IFE turbidity of all filters in operation was under 0.1 NTU. The operational team has been working on the reliability of the CFE turibidimeter, specifically sample delivery problems to this instrument.

The current CCP action for IFE alarm level exceedances (>0.15 NTU) is to place that respective filter in standby, and the current CCP action for CFE alarm level exceedances (>0.15 NTU) is to divert SWIFT Water. The actions for both of these CCPs will be modified such that IFE alarms cause that filter to move to filter-to-waste mode, and a CFE alarm causes all biofilters to move to filter-to-waste mode.

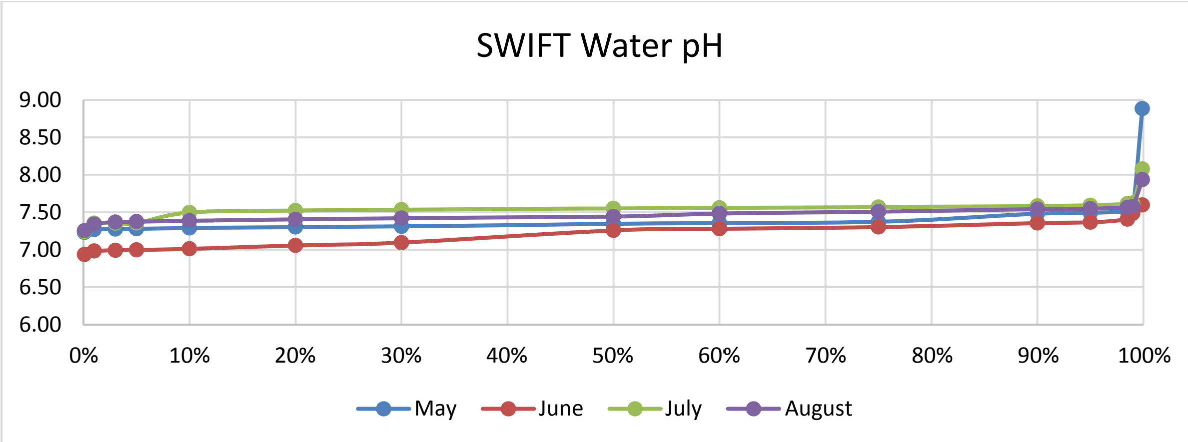


Figure 2: Distribution of Monthly SWIFT Water pH values. The infrequent high pH values are associated with continued optimization the tuning of the proportional-integral-derivative (PID) pH controller that adjusts the sodium hydroxide metering pump speed. These brief periods of elevated pH did not pose a water quality concern. Mobilization of metals within the aquifer is a concern with extended periods of low pH.

Monitoring at the SWIFTRC also includes monitoring for performance indicators as documented in Table 2, extracted from Attachment B of the UIC-IIP.

Table 5-1. SWIFTRC Non-Regulatory Performance Indicators

Constituent	Category	Value	Unit	Notes
1,4-Dioxane	Public Health	1	µg/L	CCL4; CA Notification Limit
17-β-Estradiol	Public Health	TBD	ng/L range	CCL4
DEET	Public Health	200	µg/L	MN Health Guidance Value
Ethinyl Estradiol	Public Health	TBD	ng/L range	CCL4
NDMA	Public Health	10	ng/L	CCL4; CA Notification Limit
Perchlorate	Public Health	6	µg/L	CA Notification Limit
PFOA+PFOS	Public Health	70	ng/L	CCL4; EPA Health Advisory
TCEP	Public Health	5	µg/L	MN Health Guidance Value
Cotinine	Treatment Effectiveness	1	µg/L	Surrogate for low molecular weight, partially charged cyclics
Primidone	Treatment Effectiveness	10	µg/L	
Phenytoin	Treatment Effectiveness	2	µg/L	
Meprobamate	Treatment Effectiveness	200	µg/L	High occurrence in wastewater treatment plant effluent
Atenolol	Treatment Effectiveness	4	µg/L	
Carbamazepine	Treatment Effectiveness	10	µg/L	Unique structure
Estrone	Treatment Effectiveness	320	µg/L	Surrogate for steroids
Sucralose	Treatment Effectiveness	150	mg/L	Surrogate for water soluble, uncharged chemicals with moderate molecular weight
Triclosan	Treatment Effectiveness	2,100	µg/L	Chemical of interest

TBD = to be determined

Table 2: SWIFTRC Non-Regulatory Performance Indicators (Table 5-1 of the UIC-IIP).

Pathogen Log Removal Value (LRV) is not strictly regulated but the SWIFTRC has been designed and is operated to achieve at least 12 LRV for viruses and 10 LRV for *Cryptosporidium* and *Giardia* through a combination of advanced treatment processes and soil aquifer treatment. Table 3 provides a treatment process pathogen LRV summary for recharge conditions. Table 4 provides additional monitoring that is being completed to document compliance with the LRVs for ozone and UV.

Table 5-2. SWIFTRC Pathogen LRV for PAS Recharge Water

Parameter	Floc/Sed (+BAF)	Ozone	BAF+GAC	UV	Cl2	SAT	Total
Enteric Viruses	2	0-3(TBD)	0	4	0-4	6	12-19
Cryptosporidium	4	0	0	6	0	6	16
Giardia	2.5	0-1.5 (TBD)	0	6	0	6	14.5-16

Table 3: SWIFTRC Pathogen LRV for Potomac Aquifer System (PAS) Recharge (Table 5-2 of the UIC-IIP).

Table 7-1. Additional Monitoring to Support Ozone and UV LRV [1]

Ozone LRV
Ozone Influent Temperature
Ozone Influent Flow
Liquid Phase Ozone Concentration[2]
Contact Time
CT
UV LRV
UV Intensity, each reactor
UVT, GAC Combined Effluent
Reactor Flow, each
Calculated Dose, each Lamp
Status, each

1 All continuous measurements. 15 min data will be submitted.

2 The ozone liquid phase probe will be verified with lab grab samples performed at least once per week.

Table 4: Additional Monitoring to Support Ozone and UV LRV (Table 7-1 of the UIC-IIP).

Table 5: SWIFT Water Quality and LRV Compliance

					MAY		JUNE		JULY		AUGUST	
Parameter	**Units**	**Maximum Contaminant Level (MCL) or MCL Goal (MCLG) where numerical MCL not expressed. Values noted for indicator compounds are non-regulatory screening values**	**Minimum Report Level[1]**	**Required Monitoring Frequency**	**SWIFT Water Average (#samples)[2,3]**	**SWIFT Water Maximum**	**SWIFT Water Average (#samples)[2,3]**	**SWIFT Water Maximum**	**SWIFT Water Average (#samples)[2,3]**	**SWIFT Water Maximum**	**SWIFT Water Average (#samples)[2,3]**	**SWIFT Water Maximum**
Regulatory Parameters												
Total Nitrogen (TN)	mg/L	5 monthly avg; 8 max daily	0.50	Daily	**3.15 (16)**	**4.03**	**3.70 (29)**	**5.21**	**3.48 (30)**	**5.48**	**4.98 (13)**	**7.36**
NO_3	mg/L	10	0.01	Daily	**2.14 (16)**	**2.83**	**2.54 (28)**	**3.17**	**3.00 (30)**	**4.39**	**4.04 (13)**	**5.15**
NO_2	mg/L	1	0.01	Daily	**0.43 (16)**	**0.92**	**0.82 (28)**	**1.35**	**0.05 (30)**	**0.27**	**0.02 (13)**	**0.07**
Turbidity	NTU	-		Continuous	**See Figure 1**							
Total Organic Carbon (TOC)	mg/L	4 monthly avg; 6 max	0.10	3x/Wk	**0.26 (6)**	**0.32**	**0.37 (12)**	**0.56**	**0.84 (13)**	**1.26**	**1.50 (7)**	**1.68**
pH		6.5-8.5		Continuous	**See Figure 2**							
TDS[4]	mg/L	Potomac Aquifer System Range: 694-8,720	2.5	Monthly		**671**		**738**		**719**		**632**
Microorganisms												
Total Coliform[5]	MPN/100 mL	MCLG=0	1	Daily	**<1 (14)**	**<1**	**<1 (26)**	**<1**	**<1 (29)**	**<1**	**<1 (12)**	**<1**
E. coli	MPN/100 mL	-	1	Weekly	**<1 (2)**	**<1**	**<1 (2)**	**<1**	**<1 (3)**	**<1**	**<1 (4)**	**<1**
Cryptosporidium	oocysts/L	TT, MCLG=0	0.095	Quarterly					**<0.095 (2)**	**<0.095**		
Giardia lamblia	oocysts/L	TT, MCLG=0	0.095	Quarterly					**<0.095 (2)**	**<0.095**		
Legionella	MPN/100 mL	TT, MCLG=0	10	Quarterly						**<10**		
Disinfection Byproducts												
Bromate	µg/L	10	0.15	Monthly[6]		**0.150**		**1.97**		**2.17**		**3.14**

Table 5: SWIFT Water Quality and LRV Compliance

					MAY		JUNE		JULY		AUGUST	
Parameter	Units	Maximum Contaminant Level (MCL) or MCL Goal (MCLG) where numerical MCL not expressed. Values noted for indicator compounds are non-regulatory screening values	Minimum Report Level[1]	Required Monitoring Frequency	SWIFT Water Average (#samples)[2,3]	SWIFT Water Maximum	SWIFT Water Average (#samples)[2,3]	SWIFT Water Maximum	SWIFT Water Average (#samples)[2,3]	SWIFT Water Maximum	SWIFT Water Average (#samples)[2,3]	SWIFT Water Maximum
Chlorite	mg/L	1.0	0.100	Monthly		**<0.100**		**<0.300**		**<0.100**		**<0.100**
Trihalomethanes												
Bromodichloromethane	µg/L		1.00	Monthly		**<1.00**		**<1.00**		**<1.00**		**<1.00**
Bromoform	µg/L		1.00	Monthly		**<1.00**		**<1.00**		**<1.00**		**<1.00**
Chloroform	µg/L		1.00	Monthly		**<1.00**		**<1.00**		**<1.00**		**<1.00**
Dibromochloromethane	µg/L		1.00	Monthly		**<1.00**		**<1.00**		**<1.00**		**<1.00**
Total Trihalomethanes	µg/L	80										
HAAs												
Dichloroacetic acid	µg/L		1	Monthly		**<1**		**<1**		**<0.2**		**<1**
Trichloroacetic acid	µg/L		1	Monthly		**<1**		**<1**		**<0.5**		**<1**
Monochloroacetic acid	µg/L		2	Monthly		**<2**		**<2**		**<2**		**<2**
Bromoacetic acid	µg/L		1	Monthly		**<1**		**<1**		**<0.3**		**<1**
Dibromoacetic acid	µg/L		1	Monthly		**<1**		**<1**		**<0.3**		**<1**
Total Haloacetic Acids	µg/L	60										
Disinfectants												
Monochloramine (as Cl2)[7]	mg/L	4		Continuous	**0.521**		**0.654**		**0.304**		**0.113**	
Chlorine (as Cl2)[7]	mg/L	4		Continuous	**0.523**		**0.636**		**0.449**		**0.202**	
Inorganic Chemicals												
Antimony	µg/L	6	2.00	Monthly		**<2.00**		**0.21**		**<1.00**		**<2.00**
Arsenic	µg/L	10	0.10	Monthly		**0.98**		**0.41**		**0.40**		**<1.00**
Asbestos	MFL	7	0.2	Monthly		**<0.18**		**<0.2**		**<0.2**		**<0.2**
Barium	mg/L	2	0.005	Monthly		**0.008**		**0.005**		**0.005**		**<0.005**
Beryllium	µg/L	4	0.10	Monthly		**<0.10**		**<0.10**		**<0.10**		**<0.50**
Cadmium	µg/L	5	0.10	Monthly		**<0.10**		**<0.10**		**<0.10**		**<0.50**
Chromium (total)	µg/L	100	2.00	Monthly		**<2.00**		**<2.00**		**<2.00**		**<1.00**

Table 5: SWIFT Water Quality and LRV Compliance

					MAY		JUNE		JULY		AUGUST	
Parameter	Units	Maximum Contaminant Level (MCL) or MCL Goal (MCLG) where numerical MCL not expressed. Values noted for indicator compounds are non-regulatory screening values	Minimum Report Level[1]	Required Monitoring Frequency	SWIFT Water Average (#samples)[2,3]	SWIFT Water Maximum	SWIFT Water Average (#samples)[2,3]	SWIFT Water Maximum	SWIFT Water Average (#samples)[2,3]	SWIFT Water Maximum	SWIFT Water Average (#samples)[2,3]	SWIFT Water Maximum
Copper	mg/L	1.3	0.005	Monthly		**<0.005**		**<0.005**		**<0.005**		**<0.005**
Cyanide (total)	mg/L	0.2	0.010	Monthly		**<0.010**		**<0.010**		**<0.010**		**<0.010**
Fluoride	mg/L	4.0	0.05	Monthly		**0.88**		**0.70**	**1.01 (21)**	**1.15**	**0.90 (13)**	**1.04**
Lead	µg/L	15	0.10	Monthly		**<0.10**		**<0.10**		**<0.10**		**<1.00**
Mercury	µg/L	2	0.10	Monthly		**<0.10**		**<0.10**		**<0.10**		**<0.10**
Selenium	µg/L	50	5.00	Monthly		**<5.00**		**<5.00**		**<5.00**		**<25.0**
Thallium	µg/L	2	0.10	Monthly		**<0.10**		**<0.10**		**<0.10**		**<0.50**
Organic Chemicals												
Acrylamide	µg/L	TT, MCLG=0	0.1	Monthly		**Footnote 8**	**<0.1**	**<0.1**		**<0.1**		**<0.1**
Alachlor	µg/L	2	0.05	Monthly		**<0.05**		**<0.05**		**<0.05**		**<0.05**
Atrazine	µg/L	3	0.05	Monthly		**<0.05**		**<0.05**		**<0.05**		**<0.05**
Benzo(a)pyrene (PAHs)	µg/L	0.2	0.02	Monthly		**<0.02**		**<0.02**		**<0.02**		**<0.02 (LE)**
Di(2-ethylhexyl) adipate	µg/L	400	0.6	Monthly		**<0.6**		**<0.6**		**<0.6**		**<0.6**
Di(2-ethylhexyl) phthalate	µg/L	6	0.6	Monthly		**<0.6**		**<0.6**		**<0.6**		**<0.6**
Hexachlorocyclopentadiene	µg/L	50	0.05	Monthly		**<0.05**		**<0.05**		**<0.05**		**<0.05**
Hexachlorobenzene	µg/L	1	0.05	Monthly		**<0.05**		**<0.05**		**<0.05**		**<0.05**
Simazine	µg/L	4	0.05	Monthly		**<0.05**		**<0.05**		**<0.05**		**<0.05**
Carbofuran	µg/L	40	0.5	Monthly		**Footnote 8**		**<0.5**		**<0.5**		**<0.5**
Oxamyl (Vydate)	µg/L	200	0.5	Monthly		**Footnote 8**		**<0.5**		**<0.5**		**<0.5**
Chlordane	µg/L	2	0.1	Monthly		**<0.1**		**<0.1**		**<0.1**		**<0.1**
Endrin	µg/L	2	0.01	Monthly		**<0.01**		**<0.01**		**<0.01**		**<0.01**
Heptachlor	µg/L	0.4	0.01	Monthly		**<0.01**		**<0.01**		**<0.01**		**<0.01**
Heptachlor Epoxide	µg/L	0.2	0.01	Monthly		**<0.01**		**<0.01**		**<0.01**		**<0.01**

Table 5: SWIFT Water Quality and LRV Compliance

Parameter	Units	Maximum Contaminant Level (MCL) or MCL Goal (MCLG) where numerical MCL not expressed. Values noted for indicator compounds are non-regulatory screening values	Minimum Report Level[1]	Required Monitoring Frequency	MAY SWIFT Water Average (#samples)[2,3]	MAY SWIFT Water Maximum	JUNE SWIFT Water Average (#samples)[2,3]	JUNE SWIFT Water Maximum	JULY SWIFT Water Average (#samples)[2,3]	JULY SWIFT Water Maximum	AUGUST SWIFT Water Average (#samples)[2,3]	AUGUST SWIFT Water Maximum
Lindane	µg/L	0.2	0.01	Monthly		**<0.01**		**<0.01**		**<0.01**		**<0.01**
Methoxychlor	µg/L	40	0.05	Monthly		**<0.05**		**<0.05**		**<0.05**		**<0.05**
Toxaphene	µg/L	3	0.5	Monthly		**<0.5**		**<0.5**		**<0.5**		**<0.5**
PCB Arochlor 1016	µg/L		0.08	Monthly		**<0.08**		**<0.08**		**<0.08**		**<0.08**
PCB Arochlor 1221	µg/L		0.1	Monthly		**<0.1**		**<0.1**		**<0.1**		**<0.1**
PCB Arochlor 1232	µg/L		0.1	Monthly		**<0.1**		**<0.1**		**<0.1**		**<0.1**
PCB Arochlor 1242	µg/L		0.1	Monthly		**<0.1**		**<0.1**		**<0.1**		**<0.1**
PCB Arochlor 1248	µg/L		0.1	Monthly		**<0.1**		**<0.1**		**<0.1**		**<0.1**
PCB Arochlor 1254	µg/L		0.1	Monthly		**<0.1**		**<0.1**		**<0.1**		**<0.1**
PCB Arochlor 1260	µg/L		0.1	Monthly		**<0.1**		**<0.1**		**<0.1**		**<0.1**
Total Polychlorinated biphenyls (PCBs)	µg/L	0.5										
2,4-D	µg/L	70	0.1	Monthly		**Footnote 8**		**<0.1**		**<0.1**		**<0.1**
Dalapon	µg/L	200	1.0	Monthly		**Footnote 8**		**<1**		**<1**		**<1**
Picloram	µg/L	500	0.1	Monthly		**Footnote 8**		**<0.1**		**<0.1**		**<0.1**
2,4,5-TP (Silvex)	µg/L	50	0.2	Monthly		**Footnote 8**		**<0.2**		**<0.2**		**<0.2**
Dinoseb	µg/L	7	0.2	Monthly		**Footnote 8**		**<0.2**		**<0.2**		**<0.2**
Pentachlorophenol	µg/L	1	0.04	Monthly		**Footnote 8**		**<0.04**		**<0.04**		**<0.04**
Dioxin (2,3,7,8-TCDD)	pg/L	30	5.0	Monthly		**Footnote 8**		**<5.0**		**<3.8**		**<5.0**
Diquat	µg/L	20	0.4	Monthly		**<0.4**		**<0.4**		**<0.4**		**<0.4**
Endothall	µg/L	100	5	Monthly		**Footnote 8**		**<5**		**<5**		**<5**
Epichlorohydrin	µg/L	TT, MCLG=0	0.4	Monthly		**<0.4**		**<0.4**		**<0.4**		**<0.4**
Glycophosphate	µg/L	700	6	Monthly		**Footnote 8**		**<6**		**<6**		**<6**
Benzene	µg/L	5	1.00	Monthly		**<1.00**		**<1.00**		**<1.00**		**<1.00**

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Parameter	Units	Maximum Contaminant Level (MCL) or MCL Goal (MCLG) where numerical MCL not expressed. Values noted for indicator compounds are non-regulatory screening values	Minimum Report Level[1]	Required Monitoring Frequency	MAY SWIFT Water Average (#samples)[2,3]	MAY SWIFT Water Maximum	JUNE SWIFT Water Average (#samples)[2,3]	JUNE SWIFT Water Maximum	JULY SWIFT Water Average (#samples)[2,3]	JULY SWIFT Water Maximum	AUGUST SWIFT Water Average (#samples)[2,3]	AUGUST SWIFT Water Maximum
Carbon Tetrachloride	µg/L	5	1.00	Monthly		**<1.00**		**<1.00**		**<1.00**		**<1.00**
Chlorobenzene	µg/L	100	1.00	Monthly		**<1.00**		**<1.00**		**<1.00**		**<1.00**
1,2-dibromo-3-chloropropane (DBCP)	µg/L	0.2	0.020	Monthly		**<0.020**		**<0.020**		**<0.020**		**<0.020**
o-Dichlorobenzene	µg/L	600	1.00	Monthly		**<1.00**		**<1.00**		**<1.00**		**<1.00**
p-Dichlorobenzene	µg/L	75	1.00	Monthly		**<1.00**		**<1.00**		**<1.00**		**<1.00**
1,2-Dichloroethane	µg/L	5	1.00	Monthly		**<1.00**		**<1.00**		**<1.00**		**<1.00**
1,1-Dichlororethylene	µg/L	7	1.00	Monthly		**<1.00**		**<1.00**		**<1.00**		**<1.00**
cis-1,2-Dichloroethylene	µg/L	70	1.00	Monthly		**<1.00**		**<1.00**		**<1.00**		**<1.00**
trans-1,2-Dichloroethylene	µg/L	100	1.00	Monthly		**<1.00**		**<1.00**		**<1.00**		**<1.00**
Dichloromethane	µg/L	5	1.00	Monthly		**<1.00**		**<1.00**		**<1.00**		**<1.00**
1,2-Dichloropropane	µg/L	5	1.00	Monthly		**<1.00**		**<1.00**		**<1.00**		**<1.00**
Ethylbenzene	µg/L	700	1.00	Monthly		**<1.00**		**<1.00**		**<1.00**		**<1.00**
Ethylene Dibromide (EDB)	µg/L	0.05	0.020	Monthly		**<0.020**		**<0.020**		**<0.020**		**<0.020**
Styrene	µg/L	100	1.00	Monthly		**<1.00**		**<1.00**		**<1.00**		**<1.00**
Tetrachloroethylene	µg/L	5	1.00	Monthly		**<1.00**		**<1.00**		**<1.00**		**<1.00**
Toluene	µg/L	1,000	1.00	Monthly		**<1.00**		**<1.00**		**<1.00**		**<1.00**
1,2,4-Trichlorobenzene	µg/L	70	1.00	Monthly		**<1.00**		**<1.00**		**<1.00**		**<1.00**
1,1,1-Trichloroethane	µg/L	200	1.00	Monthly		**<1.00**		**<1.00**		**<1.00**		**<1.00**
1,1,2-Trichloroethane	µg/L	5	1.00	Monthly		**<1.00**		**<1.00**		**<1.00**		**<1.00**
Trichloroethylene	µg/L	5	1.00	Monthly		**<1.00**		**<1.00**		**<1.00**		**<1.00**
Vinyl Chloride	µg/L	2	1.00	Monthly		**<1.00**		**<1.00**		**<1.00**		**<1.00**
p/m-Xylene	µg/L	-	2.00	Monthly		**<2.00**		**<2.00**		**<2.00**		**<2.00**
o-Xylene	µg/L	-	1.00	Monthly		**<1.00**		**<1.00**		**<1.00**		**<1.00**
Total Xylene	µg/L	10,000	3.00	Monthly		**<3.00**		**<3.00**		**<3.00**		**<3.0**

Table 5: SWIFT Water Quality and LRV Compliance

					MAY		JUNE		JULY		AUGUST	
Parameter	Units	Maximum Contaminant Level (MCL) or MCL Goal (MCLG) where numerical MCL not expressed. Values noted for indicator compounds are non-regulatory screening values	Minimum Report Level[1]	Required Monitoring Frequency	SWIFT Water Average (#samples)[2,3]	SWIFT Water Maximum	SWIFT Water Average (#samples)[2,3]	SWIFT Water Maximum	SWIFT Water Average (#samples)[2,3]	SWIFT Water Maximum	SWIFT Water Average (#samples)[2,3]	SWIFT Water Maximum
Radionuclides												
Alpha particles	pCi/L	15	3	Monthly		**<3**		**<3**		**<3**		**<3**
Beta particles and photon emitters	pCi/L	4 mrems/yr[9]	3	Monthly		**16**		**18**		**18**		**15**
Radium 226	pCi/L	5 (226+228)	0.1	Monthly		**<0.928**		**<1 (L2)**		**<1 (B1)**		**<1**
Radium 228	pCi/L	5 (226+228)	0.1	Monthly		**<0.864**		**<1 (L1)**		**<1 (B1)**		**<1**
Uranium	µg/L	30	0.100	Monthly		**<0.100**		**<0.100**		**<0.100**		**<0.100**
Strontium-90	pCi/L	-	varies	Monthly		**<1.61**		**<0.595**		**<0.514**		**<0.548**
Tritium	pCi/L	-	346	Monthly		**Footnote 8**		**<346**		**Footnote 10**	**<332 (2)**	**<332**
Non-regulatory Performance Indicators												
Public Health Indicators												
1,4-dioxane	µg/L	1	0.07	Quarterly		**<0.07**			**0.39 (4)**	**0.42**	**0.31 (3)**	**0.33**
17-β-estradiol	ng/L	TBD	0.4	Quarterly						**<0.4**		
DEET	ng/L	200,000	10	Quarterly						**<10**		
Ethinyl estradiol	ng/L	TBD	5	Quarterly						**<5,BA**		
Tris(2-carboxyethyl)phosphine (TCEP)	ng/L	5,000	10	Quarterly						**<10**		
NDMA	ng/L	10	2.0	Quarterly	**<2 (2)**	**<2**	**<2 (3)**	**2.4**	**<2 (4)**	**<2**	**<2 (2)**	**<2**
Perchlorate	µg/L	6	0.5	Quarterly		**1.7**				**0.74**		
Perfluorooctanoic Acid (PFOA)	µg/L	0.070 (PFOA+ PFOS)	0.02	Quarterly		**<0.02**				**<0.02**		
Perfluorooctanesulfonic Acid (PFOS)	µg/L	0.070 (PFOA+ PFOS)	0.04	Quarterly		**<0.04**				**<0.04**		
Treatment Efficacy Indicators												
Cotinine	ng/L	1,000	10	Quarterly						**<10**		

Table 5: SWIFT Water Quality and LRV Compliance

					MAY		JUNE		JULY		AUGUST	
Parameter	Units	Maximum Contaminant Level (MCL) or MCL Goal (MCLG) where numerical MCL not expressed. Values noted for indicator compounds are non-regulatory screening values	Minimum Report Level[1]	Required Monitoring Frequency	SWIFT Water Average (#samples)[2,3]	SWIFT Water Maximum	SWIFT Water Average (#samples)[2,3]	SWIFT Water Maximum	SWIFT Water Average (#samples)[2,3]	SWIFT Water Maximum	SWIFT Water Average (#samples)[2,3]	SWIFT Water Maximum
Primidone	ng/L	10,000	10	Quarterly						**<10**		
Phenytoin (Dilantin)	ng/L	2,000	20	Quarterly						**<20**		
Meprobamate	ng/L	200,000	5	Quarterly						**<5**		
Atenolol	ng/L	4,000	5	Quarterly						**<5**		
Carbemazepine	ng/L	10,000	5	Quarterly						**<5**		
Estrone	ng/L	320,000	5	Quarterly						**<5**		
Sucralose	ng/L	150,000,000	5	Quarterly						**<100,LE, LK**		
Triclosan	ng/L	210,000	10	Quarterly						**<10**		
Additional Monitoring (Ozone & UV LRV)					**SWIFT Water Average**	**SWIFT Water Minimum**	**SWIFT Water Average**	**SWIFT Water Minimum**	**SWIFT Water Average**	**SWIFT Water Minimum**	**SWIFT Water Average**	**SWIFT Water Minimum**
Ozone Virus LRV				Continuous	**5.22**	**3.32**	**5.63**	**2.75**[12]	**5.68**	**0**[11,12]	**4.26**	**2.59**[11]
Ozone Giardia LRV				Continuous	**2.73**	**1.68**[12]	**2.54**	**1.09**[12]	**2.38**	**0**[11,12]	**2.06**	**1.13**[11]
UV Dose Reactor 1	mJ/cm^2			Continuous	**>186**	**>186**	**>186**	**>186**	**>186**	**>186**	**>186**	**>186**
UV Virus LRV Reactor 1				Continuous	**>4**	**>4**	**>4**	**>4**	**>4**	**>4**	**>4**	**>4**
UV Dose Reactor 2	mJ/cm^2			Continuous	**>186**	**>186**	**>186**	**>186**	**>186**	**>186**	**>186**	**>186**
UV Virus LRV Reactor 2				Continuous	**>4**	**>4**	**>4**	**>4**	**>4**	**>4**	**>4**	**>4**

TT: Treatment Technique

[1] When minimum reporting limits varied during the quarter, the highest minumum reporting limit used is identified.

[2] Analytical results less than the reporting limit were treated as zero for the purposes of the averaging calculation.

[3] The daily samples for Total coliform were not collected when recharge was not occurring during day shift hours. In the month of May, the maximum number of daily samples was 17 days (May 15 – May 31). Recharge did not occur on May 30 and no samples were collected. The Total coliform sample was not collected on May 20 due to courier and holding time concerns. Total coliform and nutrient samples were not collected on May 25 because recharge was down most of the day. In the month of June, the maximum number of daily samples was 30. Total coliform was not collected on June 1, June 6, and June 13 due to limited or no recharge. On June 8, Total coliform and nutrient samples were not collected. On this date, the GAC vessels were operating in a duty/standby mode, and the out-

of-service vessel was placed into service. This caused the GAC CE turbidity to increase for several hours (approximately 5 hours) due to problems with air bubbles in the GAC CE turbidimeter sample line. Recharge was terminated until the turbidity decreased to normal levels, but by that time it was too late in the day to collect daily samples. The GACE CE turbidity did spike back up briefly after reinitiating recharge but was again less than 0.15 NTU within 25 minutes of restarting recharge. The June 24 samples for nitrite was improperly preserved and not analyzed. The maximum number of daily samples collected in July was 31. Total coliform and nutrients were not collected on July 22 due to limited recharge. Total coliform was not collected on July 31 because recharge was not occurring. Given the limited amount of recharge in the month of August, the daily samples reflect the data available from samples collected August 1 – August 3, and August 22 – August 31. The maximum number of daily samples during this period was 13. Total coliform was collected and analyzed on August 26 but was invalidated as described in Footnote 3.

In general, sampling of SWIFT Water does not occur unless the recharge is actively occurring. Frequent periods of starts and stops during these early months as we continue to fine tune the advanced water treatment system and test the CCPs prompted a need to identify a protocol for collecting samples when there are limited periods of recharge. In August, we added the following language to the O&M manual to address this:

1. Daily sampling at SWIFTRC should consider the following:
    a. If the SWIFTRC is recharging for more than **1 hour,** daily samples (regulatory and process) should be taken.
    b. Total Coliform (TC) samples should only be collected between the hours of **6 am and 6 pm** and should only be collected by the **SWIFTRC team.**
    c. If regulatory or process samples are being taken after the midday courier (including TC samples), they will be collected and sent to the CEL lab with the morning courier (next day).
    d. SWIFTRC team will be in charge of taking **ALL** regulatory and process samples (collection of samples, bottles requests, COCs, coordination with lab, etc) that are collected between 6 am and 6 pm.
    e. If recharge operations are started for the day **after 6 pm**, the daily SWIFT Water regulatory samples, **excluding Total coliform**, will be collected by the **Nansemond Plant Operator** (bottles will be labeled and ready to take samples)
2. **One sampling event per day is enough**. If we have an unexpected shutdown and recharge occurs within the same day, there is no need to resample.

[4] TDS of the Potomac Aquifer System is based on the averages within the upper, middle and lower Potomac Aquifer as determined during baseline monitoring.

[5] A positive TC result was documented on August 26, 2018. This prompted an operational review which identified that at the time of sample collection, the Advanced Water Treatment System was off-line (not recharging) and wellhead monochloramine addition was not occurring. This data point was therefore discarded as being unrepresentative of operational conditions. E coli was absent for this sample.

[6] Bromate Swift Water monitoring frequency was noted as weekly in the UIC submission package and was changed to monthly consistent with the bulk of the PMCLs. Bromate is monitored daily at the Granular Activated Carbon Combined Filter Effluent to ensure adequate control of bromate formation.

[7] The maximum residual disinfectant level (or MRDL) MCL for monochloramine and chlorine are based on annual averages.

[8] Samples were collected and shipped to the contract laboratory for analysis. Samples were not received within holding time. HRSD was not notified in time to collect another set of samples within the month of May.

[9] The measurement unit for beta particles and photon emitters is pCi/L while the MCL is expressed as mrem/yr. Per EPA's Implementation Guidance for Radionuclides (EPA 816-F-00-002, March 2002), the screening threshold for beta particles and photon emitters is 50 pCi/L. If sample concentrations exceed 50 pCi/L, each individual beta particle and photon emitter is converted from pCi/L to mrem using the EPA designated conversation tables, currently available in the referenced document.

[10] Sample bottle broken during shipment to contract laboratory. HRSD was not notified in time to collect another sample in the month of July.

[11] In July, there were ozone LRVs for viruses and giardia recorded at values of 0 on three dates: July 22, July 23, and July 24. Evaluation of these data identified that these were inaccurate readings due to the following: July 22 - This period (approximately 11 hours) of low virus and giardia LRV was likely caused by a problem with the ozone residual probe. It is unclear at this time why the CCP for virus LRV did not engage and bypass the filters. Nevertheless, a trend of the data showed that the ozone system was running with a relatively high dose of 95 PPD through this entire period. In addition, recharge was not happening during

this period (GAC feed pumps shut down), and the GAC Feed Pump Station was flushed prior to reinitiating recharge. Since recharge was not occurring, these data were deleted from the analysis that yielded the average and minimum LRVs shown in Table 5-1. July 23-24 - This period (approximately 8 hours) of low virus and giardia LRV was likely caused by a problem with the ozone residual probe. It is unclear at this time why the CCP for virus LRV did not engage and bypass the filters. This is being investigated. Nevertheless, a trend of the data showed that the ozone system was running with a relatively high dose of 90 PPD through this entire period. In addition to the daily laboratory verification of the ozone residual probe in triplicate, a "hot standby" ozone residual probe is also being added, and associated operating procedures are being developed.

[12] There were other individual 15-minute intervals in which the ozone virus LRV dropped below 3 for short durations, and these values are captured in the minimum LRV values in Table 5-1. These are described as follows:

6/21: LRV dropped below 3 LRV for 10 minutes and all filters were removed from service.
7/20: LRV dropped below 3 LRV for 9 minutes and then recovered. Filters stayed in service.
7/21: LRV went below 3 LRV for 10 minutes, and all filters were removed from service.
7/23 6:44 am: LRV dropped below 3 LRV for 13 minutes and then recovered. Filters stayed in service.
7/23 4:00 pm: LRV dropped below 3 LRV for 8 minutes and then recovered. Filters stayed in service.
7/26 5:30 and 6:00 am: LRV dropped below 3 LRV for 6 minutes and 18 minutes, respectively, and then recovered. Filters stayed in service.
7/28 10:00 pm: LRV dropped below 3 LRV for 9 minutes and then recovered. Filters stayed in service.
7/29 8:14 am: LRV dropped below 3 LRV for 9 minutes and then recovered. Filters stayed in service.
8/12 4:14 am: LRV dropped below 3 LRV for 17 minutes and then recovered. Filters stayed in service.
8/17 2:30 pm: LRV dropped below 3 LRV for 14 minutes and then recovered. Filters stayed in service.

Contract Laboratory Flags

(BA) Target analyte detected in method blank at or above the laboratory minimum reporting limits (MRL), but analyte not present in the sample. (B1) Target analyte detected in method blank at or above the method reporting limit.
(B1) Target analyte detected in method blank at or above the method reporting limit.
(LE) MRL check recovery was above the laboratory acceptance limits.
(LK) The associated blank spike recovery was above method acceptance limits.
(L1) The associated blank spike recovery was above laboratory acceptance limits.
(L2) The associated blank spike recovery was below laboratory acceptance limits.

Recharge Statistics

The total volume recharged during this operational period was 47.68 million gallons. 28.45 million gallons was backflushed for a net recharge of 19.23 million gallons. Brief backflushing periods occur as part of routine well maintenance, generally three times per week. During the month of August, extensive backflushing occurred as part of a corrective action associated with identifying nitrite above the MCL in the well MW-SAT, located 50-ft. from the recharge well.

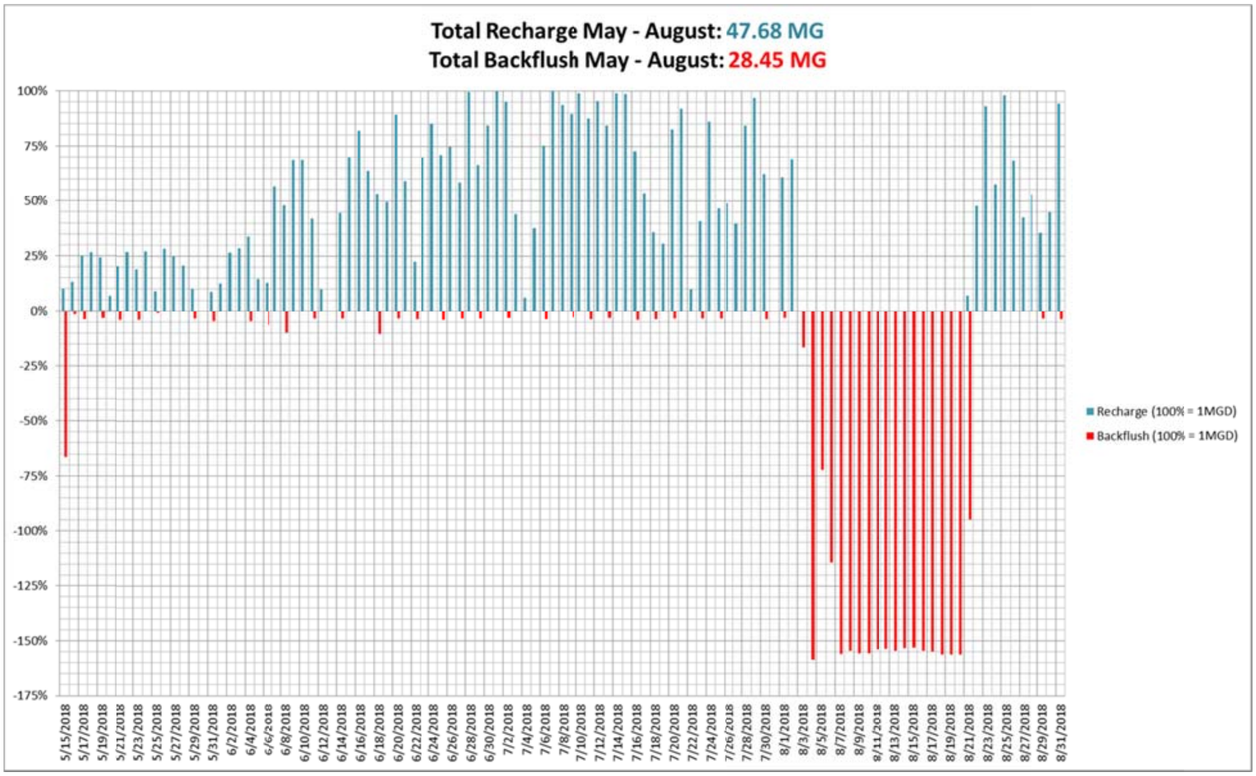

Table 6: Recharge and Backflush Volumes, May 15 – August 31, 2018.

Nitrite in MW-SAT Update

A previous report on nitrite in SWIFT Water and in the 50-ft. monitoring well, MW-SAT, was submitted to EPA Region III in August 2018 (with copies to the Virginia Department of Health (VDH) and the Virginia Department of Environmental Quality (DEQ)). This previously submitted report has been updated based upon additional comments from the VDH and is attached to this report in its final form (September 4, 2018). As described in the August report, HRSD backflushed the recharge well to remove any nitrite that may have been directly introduced via recharge of the SWIFT Water. The total volume backflushed as part of this corrective action was 26.57 million gallons.

Recharge resumed August 22, 2018. Within a week, nitrite levels in two of the eleven monitored MW-SAT intervals exceeded the nitrite MCL. As described in the report submitted to EPA Region III September 7, 2018 (with copies to VDH and DEQ), this is believed to be the result of the conversion of recharge water nitrate to nitrite. Updates on nitrite in groundwater will continue to be provided through this quarterly reporting format. Figures 3, 4 and 5 found below document nitrite and nitrate in groundwater and SWIFT Water.

Though it is clear that nitrite can be formed in excess of the MCL at MW-SAT while reducing conditions remain, based on the instability of this compound and its removal in the soil columns (refer to the August Nitrite Report), it is anticipated that nitrite in excess of the MCL will not migrate far from the recharge well. The conventional monitoring wells located 400 – 500 feet away from the recharge well will continue to be monitored daily for the presence of nitrite (and nitrate) to evaluate the areal extent of migration.

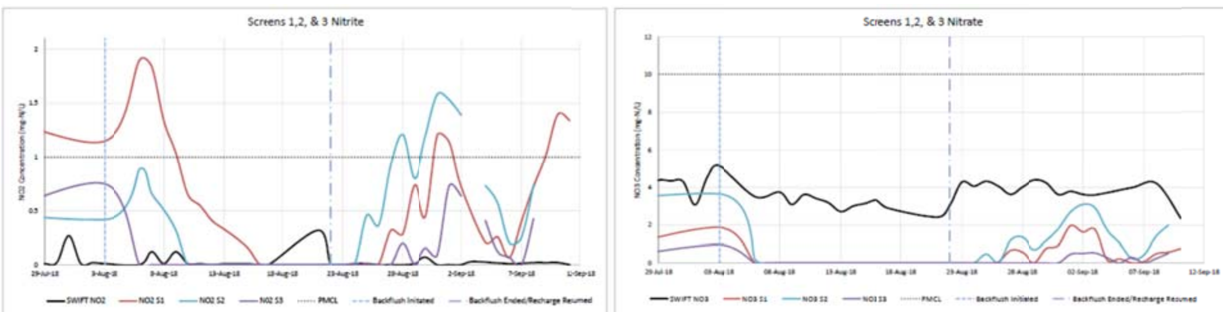

Figure 3: Average Daily Nitrite and Nitrate Concentrations in MW-SAT Screen Intervals 1 (S1), 2 (S2) and 3 (S3) relative to the nitrite PMCL and SWIFT Water concentrations (SWIFT).

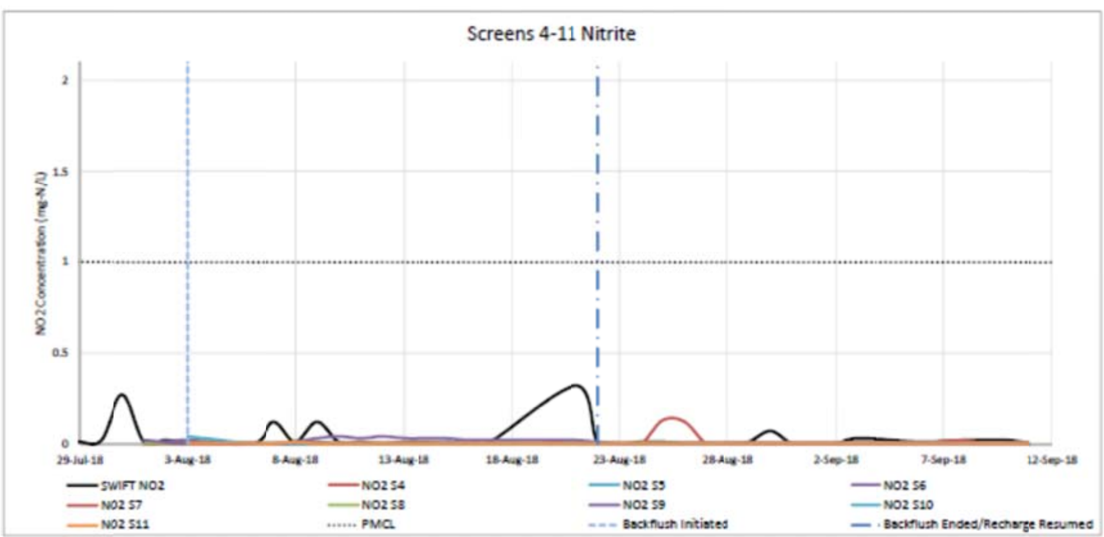

Figure 4: Average Daily Nitrite Concentrations in MW-SAT Screen Intervals 4 - 11 (S4-S11) relative to the nitrite PMCL and SWIFT Water concentrations (SWIFT). The highest recorded nitrate value in these intervals since recharge resumed was 0.13 mg/L in Screen Interval 4.

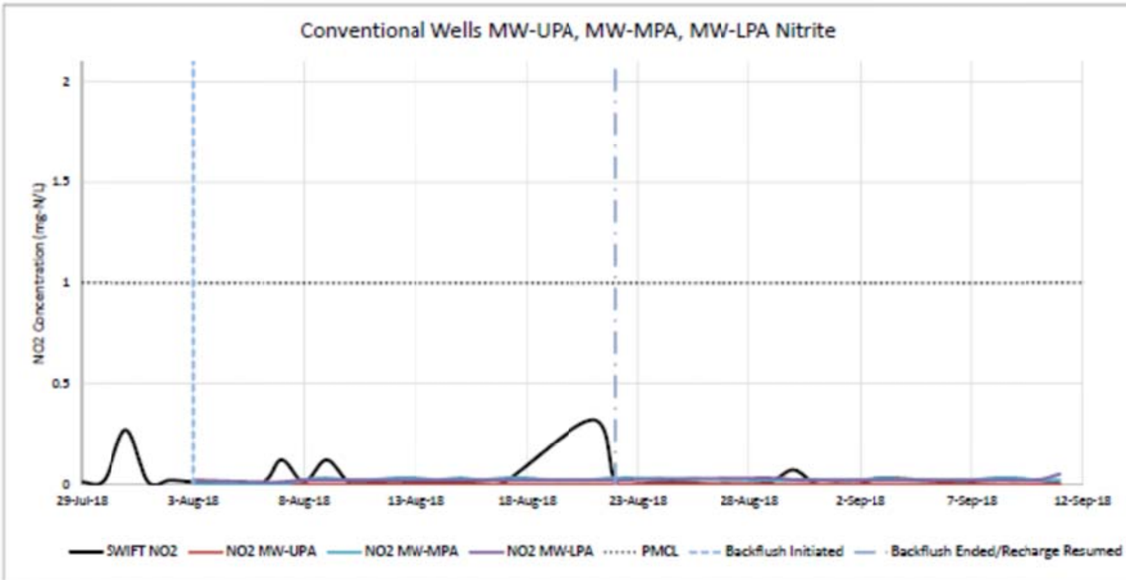

Figure 5: Average Daily Nitrite Concentrations in the conventional monitoring wells (MW-UPA, MW-MPA, MW-LPA). Nitrate values in these wells have been less than the detection limit of 0.01 mg/L during the August-September monitoring period.

Critical Control Point Modifications

Table 7 shows in redline/strikethrough format the changes that have been made to the CCPs since startup as compared to the original design documents. Figure 6 shows DCS screenshots of the system as it currently exists. The CCP modifications associated with Total Nitrogen are discussed in footnote 1 of Table 1. The remaining modifications are discussed below.

- The influent conductivity alert level was adjusted from 1,000 to 1,200 µS/cm because this was deemed sufficient for alerting operations staff.
- The preformed chloramine feed system failure CCP is currently disengaged because of programming problems associated with backup chemical feed pumps being used. This is being fixed now.
- A redundant CCP was added to further confirm appropriate monochloramine feed ahead of ozone for bromate control. This allows either a total chlorine or a monochloramine residual sensor to activate the CCP. This ensures effective ammonia as well as effective chlorine feed.
- Bromate formation is dependent on several operating parameters including ozone dose, monochloramine concentration, and background bromide. Due to the strong correlation observed between ozone dose and bromate formation, an additional CCP has been added to divert SWIFT Water in the event of elevated ozone dose. This CCP has an alert level of 80 lbs/day, an alarm level of 90 lbs/day, and an alarm level action of shifting all of the BAFs to filter-to-waste mode. Bromate control is discussed further in the SWIFTRC Quarterly Research Report issued October 11, 2018.
- As a corrective action following the nitrite PMCL exceedance in SWIFT Water, an online nitrite analyzer was installed on August 7, 2018 at the GAC combined

effluent sample point to monitor in real-time nitrite levels within the SWIFT Water. The output of this analyzer has been connected to the plant distributed control system (DCS), and a new critical control point was implemented to ensure that SWIFT Water with high nitrite values is not used to recharge the well. The critical control point will result in an automatic diversion of SWIFT Water at 0.5 mg/L NO_2-N, one half of the PMCL. Further discussion on nitrite control and corrective actions can be found in the nitrite corrective action report issued on September 4, 2018.

Parameter	Alert Value	Alarm Value	Unit	Action
Critical Control Points (CCPs)				
Influent Pump Station Conductivity	~~1,000~~1,200	1,500	microSiemens per centimeter	Divert settled water to drain pump station ~~or stop influent pumps~~
Influent Pump Station Total Inorganic Nitrogen	~~5.0~~4.0	~~6.0~~5.0	mg/L	Divert settled water to drain pump station ~~or stop influent pumps~~
Influent Pump Station Turbidity	15	20	NTU	Divert settled water to drain pump station ~~or stop influent pumps~~
Preformed Chloramine Failure on Injection	N/A	Failure	mg/L	Divert SWIFT Water
Total Chlorine Post Injection upstream of ozone	2.0	1.0	mg/L	Divert SWIFT Water
Chloramine injection upstream of ozone	2.0	1.0	mg/L	Divert SWIFT Water
Ozone Feed	N/A	Failure	N/A	~~Divert SWIFT Water and~~ Open Biofilter Backwash Waste Valve
Ozone Contactor Calculated LRV – Virus	<120% LRV Goal	<100% LRV Goal	%	~~Divert SWIFT Water and~~ Open Biofilter Backwash Waste Valve
Biofilter Individual Effluent Turbidity	0.1	0.15	NTU	~~Place filter in Standby at CCP at Alert Value. Divert filter effluent at Alarm Value~~Place that filter in filter-to-waste mode
Biofilter Combined Filter Effluent Turbidity	0.1	0.15	NTU	Place all filters in filter-to-waste mode~~Divert SWIFT Water~~
GAC Combined Effluent TOC, instantaneous online analyzer	4.0	6.0	mg/L	Divert SWIFT Water
UV Reactor Dose	<120% of Dose Setpoint	<105% of Dose Setpoint	%	Divert SWIFT Water
Free Chlorine CT[1] This CCP is not being used since free chlorination of the SWIFT Water is not currently being practiced.	<120% of CT Target	<105% of CT Target	%	Divert SWIFT Water
GAC Combined Effluent Nitrite	0.25	0.50	mg/L	Divert SWIFT Water
SWIFT Water TN	4.5	6.0	mg/L	Divert SWIFT Water

Parameter	Alert Value	Alarm Value	Unit	Action
Ozone dose	80	90	lbs/day	Place all filters in filter-to-waste mode

Table 7. Hazard Analysis and Critical Control Point: Critical Control Points and Critical Operating Parameters

Revision Log (Revisions from report issued 091818 following VDH comments)

1. Table 1: Added in modification of TIN CCP and addition of TN CCP with explanatory footnote 1.
2. Table 5: Modified 2nd column header “MCL” to describe various limits, goals, screening values.
3. Table 5: Modified 3rd column header “Detection Limit” to “Minimum Reporting Level”.
4. Table 5: Added a footnote describing the calculation of average concentrations.
5. Table 5: Modified MCLs to reflect Treatment Technique (TT) where applicable, added regulatory targets for TN and TOC, and corrected unit conversion errors for the following: alachlor, atrazine, chlordane, 1,2-Dichloroethane and 1,1-Dichloroethylene.
6. Table 5: Documented the average TDS concentrations in the Potomac Aquifer System in the table and added a corresponding footnote.
7. Table 5: Added a footnote describing the reporting of beta particles and photon emitters and the evaluation of compliance relative to the MCL to address the difference in reporting units (units of the MCL versus those of the analytical results).
8. Table 5: Added row for Total Trihalomethanes (TTHMs) and Total Haloacetic Acids (HAAs) and modified each of the sections to reflect the combined MCLs (e.g.,Total Trihalomethanes MCL = 80 µg/L). Assessment for TTHM and HAA compliance is based upon the sum of the individual parameters.
9. Table 5: Corrected ethylene dibromide (EDB) concentrations to <0.020 µg/L for each month.
10. Table 5: Added PCB Arochlor to arochlor identification (e.g., AR1016 revised to PCB Arochlor 1016). Identified individual MRLs for each of the arochlors and removed the Total PCB MRL. Assessment for Total PCB compliance is based upon the sum of the individual arochlors.
11. Table 5: Indicated that Radium 226 and 228 MCLs are based upon sum of each.
12. Table 5: Added the screening values or trigger limits associated with the non-regulatory indicators.
13. Table 5: Renumbered footnotes based upon the aforementioned additions.
14. Critical Control Points (CCPs): Added in a section on CCP modifications made since the original UIC-IIP submission.